CLAIMS

Therefore, having thus described the invention, at least the following is claimed:

1. A polymer, comprising:
   a photodefinable polymer including a sacrificial polymer and a photoinitiator.

2. The polymer of claim 1, wherein the photoinitiator is a negative tone photoinitiator.

3. The polymer of claim 1, wherein the photoinitiator is a positive tone photoinitiator.

4. The polymer of claim 1, wherein the sacrificial polymer is selected from polynorbornenes, polycarbonates, polyethers, polyesters, functionalized compounds of each, and combinations thereof.

5. The polymer of claim 1, wherein the sacrificial polymer includes polynorbornene.

6. The polymer of claim 3, wherein the polynorbornene includes alkenyl-substituted norbornene.

7. The polymer of claim 1, wherein the photoinitiator is a free radical generators.

8. The polymer of claim 1, wherein the photoinitiator is selected from, bis(2,4,6-trimethylbenzoyl)-phenylphosphineoxide, 2-benzyl-2-dimethylamino-1-(4-morpholinophenyl)-butanone-1, 2,2-dimethoxy-1,2-diphenylethan-1-one, 2-methyl-1[4-(methylthio)- phenyl]-2-morpholinopropan-1-one, 2-methyl-4'-(methylthio)-2-morpholino-propiophenone, benzoin ethyl ether, and 2,2'-dimethoxy-2-phenyl-acetophenone, and combinations thereof.

9. The polymer of claim 1, wherein the photoinitiator is selected from, bis(2,4,6-trimethylbenzoyl)-phenylphosphineoxide and 2-benzyl-2-dimethylamino-1-(4-morpholinophenyl)-butanone-1.

10. The polymer of claim 1, wherein the sacrificial polymer is about 1 to 30% by weight percent of the photodefinable polymer, wherein the photoinitiator is from about 0.5 to 5% by weight of the photodefinable polymer, wherein the solvent is about 65% to 99% by weight percent of the photodefinable polymer.

11. A method for fabricating a structure, comprising:

disposing a photodefinable polymer onto a surface, wherein the photodefinable polymer includes a sacrificial polymer and a photoinitiator selected from a negative tone photoinitiator and a positive tone photoinitiator;

disposing a gray scale photomask onto the photodefinable polymer, wherein the gray scale photomask encodes an optical density profile defining a three-dimensional structure to be formed from the photodefinable polymer;

exposing the photodefinable polymer through the gray scale photomask to optical energy; and

removing portions of the photodefinable polymer to form the three-dimensional structure of cross-linked photodefinable polymer.

12. The method of claim 11, wherein removing includes:

removing unexposed portions of the photodefinable polymer to form the three-dimensional structure.

13. The method of claim 11, wherein removing includes:

removing exposed portions of the photodefinable polymer to form the three-dimensional structure.

14. The method of claim 11, further comprising:

disposing an overcoat layer onto the three-dimensional structure; and

decomposing the photodefinable polymer, thermally, to form a three-dimensional air-region.

15. The method of claim 14, wherein decomposing includes:

maintaining a constant rate of decomposition as a function of time.

16. The method of claim 14, wherein decomposing includes:

maintaining a constant rate of mass loss of the photodefinable polymer.

17. The method of claim 14, wherein decomposing includes:

heating the structure according to the thermal decomposition profile expression

$$T = \frac{E_a}{R}[\ln\frac{A(1-rt)^n}{r}]^{-1}$$

where R is the universal gas constant, t is time, n is the overall order of decomposition reaction, r the desired polymer decomposition rate, A is the Arrhenius pre-exponential factor, and E_a is the activation energy of the decomposition reaction.

18. The method of claim 11, wherein the three-dimensional structure has a spatially-varying height.

19. A structure, comprising the three-dimensional structure formed using the method of claim 11.

20. A structure, comprising the three-dimensional air-region formed using the method of claim 14.

21. A structure, comprising the three-dimensional air-region formed using the method of claim 15.

22. A structure, comprising the three-dimensional air-region formed using the method of claim 17.

23. A method of decomposing a polymer, comprising:

providing a structure having a substrate, an overcoat layer, and a polymer in a defined area within the overcoat layer;

maintaining a constant rate of decomposition as a function of time;

removing the polymer from the area to form an air-region in the defined area.

24. The method of claim 23, wherein maintaining includes:

heating the structure according to the thermal decomposition profile expression

$$T = \frac{E_a}{R}[\ln \frac{A(1-rt)^n}{r}]^{-1}$$

where R is the universal gas constant, t is time, n is the overall order of decomposition reaction, r the desired polymer decomposition rate, A is the Arrhenius pre-exponential factor, and E_a is the activation energy of the decomposition reaction.

25. A structure, comprising:

a substrate;

an air-region area having a spatially-varying height; and

an overcoat layer disposed onto a portion of the substrate and engaging a substantial portion of the air-region area.

26. The structure of claim 25, wherein the air-region area has a non-rectangular cross-section.

27. The structure of claim 25, wherein the air-region area has an asymmetrical cross-section.